Ain Shams University
Faculty of Science
Chemistry Department

Development of Electrochemical Sensors Based on Electro-polymerized Materials for Determination of Some Clinically and Environmentally Relevant Species

A Thesis
Submitted to Chemistry Department – Faculty of Science – Ain Shams University for Requirements of the Degree of Doctor of Philosophy (Ph.D) of Science in Chemistry

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Approval Sheet

Development of Electrochemical Sensors Based on Electro-polymerized Materials for Determination of Some Clinically and Environmentally Relevant Species

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بِسْمِ اللّهِ الرَّحْمنِ الرَّحِيمِ

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا
إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ
الْعَلِيمُ الْحَكِيمُ

صدق اللَّهُ العظيم

سورة البقرة – الآية (٣٢)

Dedication

I do appreciate my god for giving me great father and mother who are enlightening and always supporting me in all my life

I also thank my family for continuous encouragement and help

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Abbreviations

Abbreviation	Full name
2-AP	***2-Aminophenol***
4-ABA	***4-Aminobenzoic acid***
4-NP	***4-Nitrophenol***
A	***Surface area***
AA	***Ascorbic acid***
AFM	***Atomic force microscopy***
AGCE	***Activated glassy carbon electrode***
c	***Concentration***
CA	***Chronoamperometry***
CAP	***Chloramphenicol***
CC	***Catechol***
CMEs	***Chemically modified electrodes***
CNTs	***Carbon nanotubes***
CP	***Chronopotentiometry***
CV	***Cyclic voltammetry***
CVD	***Carbon vapor deposition***
DA	***Dopamine***
DPV	***Differential pulse voltammetry***

D_R	*Diffusion coefficient*
EDX	*Energy dispersive X-ray spectroscopy*
E_p	*Peak potential*
$E^{\prime\circ}$	*Standard formal potential*
FTIR	*Fourier transform infrared spectroscopy*
GC	*Gas chromatography*
GCE	*Glassy carbon electrode*
HPLC	*High-performance liquid chromatography*
HQ	*Hydroquinone*
I_p	*Peak current*
k_s	*Apparent heterogeneous rate constant*
LOD	*Lower limit of detection*
LSV	*Linear sweep voltammetry*
MS	*Mass spectrometry*
MWCNTs	*Multi-walled carbon nanotubes*
n	*Number of electrons transferred*
NPV	*Normal pulse voltammetry*
***p*-ABSA**	*p-Aminobenzene sulfonic acid*
PBS	*Phosphate buffered solution*
p-DAN	*Poly(1,5-diaminonaphthalene)*

PMEs	***Polymer-modified electrodes***
PNT	***p-Nitrotoluene***
R.S.D	***Relative standard deviation***
RC	***Resorcinol***
SAM	***Self-assmbled-monolayers***
SCE	***Saturated calomel electrode***
SEM	***Scanning electron microscopy***
SFGs	***Surface functional groups***
SPM	***Scanning probe microscopy***
STM	***Scanning tunneling microscopy***
SWCNTs	***Single-walled carbon nanotubes***
SWV	***Square wave voltammetry***
TEM	***Transmission electron microscopy***
UA	***Uric acid***
UGCE	***Unactivated glassy carbon electrode***
XPS	***X-ray photoelectron spectroscopy***
XRD	***X-ray diffraction spectroscopy***
α	***Electron transfer coefficient***
υ	***Scan rate***

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